THE POTENTIAL IMPACT OF A SEISMIC SURVEY ON THE AQUATIC FAUNA OF LAKE ALBERT ESPECIALY FISH

A CONTRIBUTION TO THE HERDMAN PETROLEUM (UGANDA) PTY LTD: LAKE ALBERT SEISMIC SURVEY ENVIRONMENTAL IMPACT ASSESSMENT

DRAFT REPORT

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Prepared for:

Hardman Petroleum (Uganda) Pty Ltd
Lake Albert Seismic Survey

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ACRONYMS

CAO	Chief Administrative Officer
DFO	District Fisheries Officer
EIA	Environmenral Impact Assessment
FDO	Fisheries Development Officer
FIRI	Fisheries Research Institute
NARO	National Agricultural Research Organisation
NEMA	National Environmental Management Authority
LC	Local Council
ARDC	Assistant Resident District Commissioner
RDC	Resident District Commissioner

ACKNOWLEDGEMENTS

The Fisheries Specialists is grateful to Mr Deo Mukiibi the Deputy Commissioner for Fisheries and Mr Robert Kasande of the Petroleum Exploration Department for their assistance and advice rendered during the study. The consultant is also grateful for constructive comments from the RDCs and LCs officials, of Hoima and Masindi, the CAO and DFO for facilitating the work. The readily and active participation of the communities at the landings visited was a source of encouragement and is greatly appreciated. The fisheries specialist would also like to thank other members of the study team for their collaborative spirit and last but not least Mr Keya the coxwain who piloted the team effeciently and safely on the lake.

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1. Background to the Study

1.1. Uganda Government and the Democratic Republic of Congo have signed an Agreement for a joint exploration and development of Hydrocarbons within the Albertine Graben area. One of the preliminary activities in the exploration is a survey which would indicate potential areas for further activities which would lead to actual drilling.

1.2. It is proposed that a Seismic Survey of Lake Albert be undertaken in an area refered to as Contract Area 2 (Figure 1). The survey will be done using a catamaran, dragging a 900 meter, 48 channel streamer and airgun of 200 psi. This straemer is significantly smaller than the standard 1,000 psi guns used in marine seismic surveys.

1.3. The streamer cable is a newly developed non-fluid filled floatation cable with 48 hydrophones mounted in hydrophone nodes. This equipment is much improved and environmentally friendly due to the non-use of oil in the cable, compared to the previous cables used in similar surveys.

1.4. The survey is to be undertaken in the area indicated in Figure 1 as Contract Area 2 by Hardman Petroleum (Uganda) Pty Ltd, using the services of the Division of Marine Geology and Geophysics, of the University of Arizona as the contractor. Contract Area 2 runs approximately from Bugoigo fish landing to south of Buhuka just after Hankondo fish landing (Figure 1). The survey will cover a total of 1,014 line kilometers, starting 1 kilometre from the shore line or a 3-5 metre water-depth. It will threfore not effect the fauna, flora and activities that take place very near the shoreline.

1.5. Under the National Environmental Statute of the National Environmental Management Authority (NEMA), it is a requirement that any undertaking which is likely to affect the environment must submit an environmental impact assessment (EIA).

1.6. This study was undertaken to examine the potential impact of the seismic survey on the Lake Albert Environment. The study was undertaken by a team of experts who included a Geographical and Petroleum Exploration specialist, Environmental specialist, Sociologist and Gender specialist, a Wildlife specilist and a Fisheries specialist.

1.7. The objectives of the study were to:

a). study the style of life (livelihood) of the communities living in the area;

b). Study the productivity of the lake basin including the limnology, primary and secondary productivity, the present fisheries and its past history, ecosystem diversity, fish species diversity, biology and ecology of the fishes, and fisheries technology;

c). Hold discussions with lakeside communities and obtain the views of the lakeside communities and local authorities on the planned survey and exploration; and brief, sensitize and solicit support of the survey.

d). Identify, assess resource users and all stakeholders;

e). assess the potential impacts of the seismic survey;

f). Recommend series ofmeasures to mitigate, remove or minimize negative environmental impacts of the survey;

g). Propose appropriate environmental measures and Action Plan.

1.2. This report covers issues related to fisheries and aquatic productivity

2. Methodology

2.1. The information provided in this report was collected through:

a). Review existing of literature and data;

b). Interviews of relevant officials especially those in the fisheries sector including the Commissioner for fisheries and research scientists at the Fisheries Research Institute (FIRI) of the National Agricultural Research Organisation (NARO);

c). Discussion with the local authorities in the Districts of Masindi and Hoima including RDCs, CAOs, LCs; and DFOs;

d). Visits to fish landings and holding discussions with fishermen, LCs, fish landing communities, fisherfolk, and other people engaged in other activities along the lake; recording of the fish catches and of fishery related activities at the landings.

2.2. The information collected in respect to fisheries included:

a). the importance of the lake as a source of fish;

b). the ecological zones of the lake;

c). fish productivity processes including physico-chemical and biological processes;

d). the fishes of the lake including the biology and ecology of the major commercial species;

e). the methods of exploting the fishes.

2.3. In each of the cases, the potential impacts of the seismic survey were examined and mitigation measures for negative impacts proposed. Conclusions and recommendations were given on the basis of the the observations.

3. Observations

3.1. Introduction

3.1.1. The people consulted and the landings visited are given in Annex I to this report. Sixteen landing sites (Annex II) were surveyed and group discussions involving 143 were held at six of the landings.

3.2. Importance of the Fisheries

3.2.1. Fisheries are very important in the Ugandan economy. Up to 17% of the country's surface area is covered by lakes and rivers which are important sources of fish. The fishing industry provides emplyment to over 0.5 million Ugandans. It is the cheapest source of animal protein human food accounting for over 50% of the animal protein supply. Fish is a major export earner and in 1996 ranked second only to coffee and earned US $ 43.05 million.

3.3. The Lake Albert Ecosystem

3.3.1. Lake Albert is located in the Western arm of the Rift Valley between latitude 1° 0' N and 2° 20' N and longitude 30° 20' E and 31° 20' E. It lies at an altitude of 618 metres above sea level and covers an area of 5270 km^2 of which Uganda accounts for 2850km^2 only. It has an average depth of 40 m and a maximum depth is 58 m. The lake is about 150 kms long and 35 kms wide.

3.3.2. Lake Albert has two major inflows, River Semliki in the south and the Victoria Nile in the north and one outflow through the Albert Nile. There are four smaller rivers entering the lake (Muzizi, Nguse, Wambabya and Waki) the last two of which lie in Contract Area 2.

3.3.3. A considerable portion of Contract Area 2, especially the northern part, is occupied by wetlands which are characterized by swamps, fringing swamps, semi or enclosed lagoons and bays. These wetlands and marginal vegetation are important breeding and nursary grounds for some species especially the tilapiines. They also act as refugia for some species especially haplochromines and are therefore important in conservation of biodiversity. The survey will, however not affect them as it will not be carried out along the shoreline.

3.3.4. Contract Area 2 has a Fisheries of considerable importance to people living on the Ugandan portion of the lake.

3.4. Fish Production Processes

3.4.1. The productivity of the lake depends upon the physical, chemical and biological processes. The physico-chemical processes include PH, light, temperature and nutrient status. These processes influence the production of different organisms notably algae, micro-invertebrates (zooplankton) and macro-invertebrates (insects, crustaceans & mulluscs) and finally fish upon which man depends.

3.4.2. Lake Albert has surface temperature 26-29°C, a PH of 8-9.5, Conductivity of 67-73 K0 μ/cm, total ionic composition: 200 $mg.l^{-1}$ and total dissolved solids of 565 $mg.l^{-1}$.

3.4.3. The Lake Albert ecosystem is ecologically very efficient. The lake is well mixed to the bottom for most of the year and undergoes limited stratification (Talling 1963). This facilitates good circulation of nutrients and oxygen through the entire water column but can also mix any contaminants entering the lake widely. Most of the ecological niches of the lake are occupied (Beadle 1981) and this provides an efficient flow of energy through the lake.

3.4.4. A survey of the lake by Holden (1963) indicated that the lake was in a state of nutrient balance. This may no longer hold because due to impact from activities in the catchment area eg. the leaching of salts from Kibiro salt works. Our observations during the study indicated the lake was becoming nutrient enriched as algal blooms were presnt on the lake.

3.4.5. There is infact evidence from recent research that phytoplankton primary production and other processes in the lake has changed over the past 30 years (Talling 1963, Mugidde 1992). Present temperatures of Lake Albert are 0.5°C higher than that measured by Talling (1963) in 1961 (Lehman *et al.* 1997), a situation which parallels that recorded in Lake Victoria (Hecky 1993). Field observations during the study suggest that the lake may as in the case of Lake Victoria be dominated by blue green algae.

3.4.6. A survey of the micro and macro-invertebrated was carried by Holden (1963) at a station 46 m deep and 16 km north-west of Butiaba. A similar survey was carried out by Lehman *et al.* (1997). Cyclopoid copepods dominate Lake Albert (Figure 3). The crustacean zooplankton in Lake Albert include *Mesocyslops aequatorialis aequatorialis, M. ogunnus, Thermocyclops neglectus, Thermodiaptomus galebi, Daphnia lumholtzi monacha, Diaphanosoma excisum, D. mongolianum, Ceriodaphinia cornuta, C. dubia, Moina micrura and Caridina nilotica.* Holden (1963) also recorded some *Chaoborus* insect from the lake. Species composition differs between inshore and offshore waters for instance *Daphia monacha* is abundant in the off-shore waters of the lake while *Caridina nilotica* is present throughout the off-shore waters of the lake.

3.4.7. All the micro and macro-invertebrates listed above form food of the important commercial fish species of the lake.

3.5. The Fishes of Lake Albert Their Ecology, Biology and Distribution

3.5.1. The Fish Fauna

3.5.1.1. The distribution of families, genera and species of fish in Lake Albert is indicated in Table 1. The fish fauna of Lake Albert is different from those of other lakes (Greenwood 1958). The lake has a nilotic in fauna which is similar to that of Lake Turkana, the Nile system below Lake Albert, the River Congo basin and West Africa. For instance, *Lates spp, Hydrocunus spp* and *Polypterus senegalis* occur in lake Albert and many other lakes in

Hydrocynus, Lates and *Alestes*.

3.5.3.3. Hankondo and Kitebere the three dominant spp are *Hydrocynus* followed by *Lates* and *Bagrus boyad*

3.5.3.3. Bugoma landing sites however have *Lates spp Hydrocynus* and *Bagrus* as dominant species in that order.

3.5.3.4. The three dominated species indicated per landing sampled are of commercial importance which are exploited for local markets largely in smoked form and for cross border trade when light or heavily salted and sundried. *Alestes, Hydrocynus* and *Lates* are favoured export commodities for markets in the Democratic Republic of Congo and Southern Sudan, while when smoked in addition to *Synodontis bayad* are widely sought after in Northern and Western Regions of Uganda.

3.5.4. The Biology and Ecology of Major Commercial species

3.5.1. The three most important commercial species of Lake Albert are: *Hydrocynus, Alestes, Lates, Bagrus* and Tilapiines. Notes of the key biological and ecological parameters of these species are given below.

3.5.2. Nile perch (*Lates niloticus*)

3.5.1.1. In Uganda, there are two species of Nile perch. These are *Lates macrophthalmus* and *Lates niloticus*. They are native to Lake Albert and Albert Nile. Fossil evidence suggests that they were present in the Lake Victoria basin during the Pleistocene about 25 million years ago (Beadle 1961). In Lake Albert, *L. macrophalmus* mainly inhabits waters deeper than 20 metres while *L. niloticus* is mainly found in shallower waters of less than 20 m. In Lake Victoria, *L. niloticus* is found in waters up to 50 m deep. Of the two species, *L. niloticus* is the most commercially important and was introduced in lakes Victoria and Kyoga. *L. niloticus* can grow to a length of 2 m and a weight of 180 kg. In Lake Albert *L. niloticus* of less than 20 cm feed mainly on invertebrate especially *Caridina nilotica* and then shifts to a fish diet with size. *L. niloticus* breeds throughout the year with peaks in the rainy season. Fish of about 1.2 cm are mainly restricted to shallow inshore areas among littoral weeds.

3.5.3. Hydrocynus species

3.5.3.1. There are two species of *Hydrocynus* in Uganda, *Hydrocynus forskahlii* and *H. vittatus*. Both species are confined to Lake Albert and the Albert Nile. *Hydrocynus* species have firmly fixed fang-like teeth. Although they have testy flesh, the muscles contain many small bones. Adult *H. forskahlii* are between 26 - 59 cm total length and weigh on average 1 kg. They are widely distributed both inshore and offshore. They feed on insect larvae, crustaceans and small fish. *H. vittatus* can grow to a length of 63 cm (Greenwood, 1962). It is mainly restricted to shallow inshore waters of the lake and feed on fishes.

3.5.4. Alestes species

3.5.4.1. There are at least 3 species of *Alestes* in Uganda. These include: *A. dentex, A. baremose,* and *A. macrolepidotus*. Of these, *A. baremose* is commercially the most important. Three other species. *Brycinus jacksonii, B. sadleri,* and *B. nurse*, which previously belonged to this genera are now under the genus *Brycinus*. *Alestes baremose* is restricted to Lake Albert and the Albert Nile. Adult *A. baremose* can grow to a length of 35 - 55 cm. It is most abundant in inshore areas. It feeds on insects and crustacea and breeds in shallow inshore areas especially along the rivers.

3.5.5. Bagrus spp

3.5.5.1. There are two species of *Bagrus* in Lake Albert, *B. docmac and B. bayad. B. bayad* is found only in Lake Albert. *B. docmac* is more widely distributed occurring in lakes Victoria, Kyoga, Albert, Edward, George and Nabugabo. They can grow to a length of 100

cm and a weight up to 50 kg. They feed mostly on insect larvae, crustaceans and small fishes especially haplochromines. They breed in wave washed rocky shores (Corbet 1961) but juveniles have also been recovered from rivers and rocky shore sand beaches (Whitehead 1959).

3.5.6. Tilapiines (Ngege)

3.5.6.1. There are three Tilapiines species in Lake Albert. These are *Oreochromis niloticus, O. leucostictus, Tilapia zillii,* and *Sarotherodon galilaeus.* One major characteristic of *Oreochromis* species is that they are all female mouth brooders. The females keep the eggs in their mouth until they hatch. The young are also protected by taking cover in the mouth of their mother until they have reached a safe size. Disturbance of brooding females as may take place where nets such seines are dragged along the lake bottom or fishing by beating water is detrimental to this fishery. The seismic survey could have an effect on breeding individual if carried out during the breeding season. *Tilapia zilli* spawns on clear substrate and guards the eggs. Some biological characteristics specific to some tilapiine species are given below.

3.5.6.2. *O. leucostictus* is found in shallow inshore areas near papyrus fringes. They feed on phytoplankton and plant debris. They can tolerate low oxygen tensions and juveniles are found in shallow deoxygenated lagoons. Breeding can start as early as 8 cm in lagoons (Welcomme 1968) but in the lakes the smallest ripe males are about 15 cm SL and females are 13 cm (Welcomme 1968)..

3.5.6.3. *O. niloticus* (Nile tilapia) is by far the most economically important and widely distributed tilapiine. In Uganda, the species is native only to lakes Albert, Edward and George. It has however, been introduced to virtually all the water bodies in Uganda including lakes Victoria, Kyoga and the Koki lakes. They are mainly restricted to shallow inshore waters (<10 m). They feed on phytoplankton and bottom detritus but occasionally ingests crustaceans, insect larvae and zooplankton. They spawn in shallow inshore areas over sand bottoms.

3.6. Ecological Zones

3.6.1. The bathymentry map (Figure 2) show that Lake Albert offers a variety of habitats which can be occupied by different organisms. The costline comprises bays and lagoons many of which have extensive wetlands and marginal macrophytes. The variuos habitats can form ecological zones suitable for certain organisms especially fish. For instance, the lagoons and around Bugoigo offer suitable habitat and are dominated by tilapiines.

3.6.2. Shallow waters not only provide ideal breeding grounds for Tilapines but are also habitat for adult for adult Tilapines while the associated swamps, bays and lagoons provide feeding grounds, refugium sanctuary nurseries for other species at the juvenile stages of their life cycle.

3.6.3. The area under survey is mostly between 30 and 50 meters in depth. These are ideal habitant for *Hydrocynus, Lates, Bagrus* and *Mormyrids*.

3.7. Methods of Fish Exploitation

3.7.1. The fishing industry is dominated by artisanal fisherfolk communities who depend on it as their source of livelihood. The fishing crafts consist of planket Ssese canoes.

3.7.2. The fishing gears used on the lake consist of gill nets, seine nets and hooks. The gill nets are the most common fishing gears. Women also fish in shallow inshore areas for Alestes using perforated basin.

3.7.3. Different fishing methods are used on the lake including the areas to be surveyed but mainly depend on the target species eg. *Hydrocynus*. Small mesh gill nets of 2.5 to 5 inches mesh surface set on the surface often in water not more than 30 metres. Large mesh nets of 6 inches to more than 10 inches are set in deeper waters at varying depth aiming at *Lates, Bagrus, Mormyrids, Synodontis* and other larger species. The surface set gill net fishing is likely to be affected by the seismic survey due to the towing of the boom and an arrangement will need to be made to avoid this by fishermen being requested not to set their net along the path of the catamaran during the survey time.

3.7.4. Long lines with live baits target fish eating species like *Lates* and are mostly set in deep waters. These too might be affected by the towing of the boom.

3.7.5. Traps and Basket fishing are exclusively used in shallow waters an is swamps to catch *Protopterus* and *Clarias* and other swamp dwelling fish species. These will not be affected by the towing of the boom.

3.7.6. Fishing is done mainly at night but in some places eg. Bugoigo area, the southern landings from Butiaba fishermen go out fishing duirng day and night.

3.7.7. Some fishermen set their nets and guard them from theft or drifting in case of windy conditions. Other fishermen set nets in an arc and drive fish into the nets by beating water.

4. Potential effects of the Seismic Survey on the Fishery

4.1. Positive Effects

4.1.1. Given the description of the Technology to be used in Seismic survey already described in chapter 5 the positive potential anticipated during the survey are much localized and short leaved. These will include:

a) increased nutrient mixing due to sound explosion of the air gun.

b) increased production of bacteria, phyto and zooplankton due to possible release of locked up nutrients.

c) increased oxygenation due to sound waves, water collum in an area of at least more than 900 meters around the air gun since the 48 hydrophones on the streamer are targeting this area.

d) increased fish production from gears set in areas adjacent to source of sound as fish tend to run away from sound waves thus involuntarily getting caught in the nets. Similar methods though prohibited are used by use of sound producing methods through release of enclosed are (e.g beating the water and use of tychoons on major lakes.

4.2 Negative Effects

4.2.1. In addition to the positive potentials of the Seismic Survey, the following negative effects to the fishery are likely to occur. However, most of them may be of short duration, minimized or completely neglected (illuminated) if timely mitigations are put in place. Potential negative areas to the proposed mode of survey are:

a) Eutrophication of the lake arrising from exessive nutrient release but this is unlikely and even if it happened would be nuetrilised soon because of the strong current of River Semuliki which flow at the botom of the lake from the south and joins Albert Nile at the northern tip of the lake.

b) Some fish species especially those in deep waters e.g *Lates, Bagrus* and *Synodontis* may be affected.

c) Breeding grounds and nurseries may be affected especially the mouth brooders which might be shocked and release the eggs, larvae that cannot survive on their own. However nurseries which are protected by swamps do not get affected as the swamps absorb the sound.

d) The hydrophone cord which carry the sensors is likely to get entangled in the fishing gears (gill nets and long lines if they are set on the surface.

e) The dragging of the boom will interfere will surface set gill nets and long lines

4.3. Proposals for Mitigations of Negative Effects

4.3.1. Potential negative effects of Seismic survey may be minimized or illiminated through the following measures:

a) Using an air gun of low psi which will be as small as possible yet be able to achieve the obljective of the study.

b) Avoid operation near the fish breeding and nursery grounds which are open sandy beaches. Bays, lagoons as well as the wetlands which also besides being feeding grounds and refugium act as a reseviour of species biodiversity.

c) The peak of fish breeding activities is in the rainy season which should be avoided. Sensitize the fisherfolk and seek their cooperation avoiding setting their gears in areas of operation which should be announced in good time using available mass media and local authorities. Radio announcements should local languages of the fisher communities around the lake eg. Runyoro, Alur, Lugbara, Luo and Kishwahili.

d) Provision should be made by the survey team to compensate for any fishing gear destroyed.

5 Environmental Measures and Action Plan

- The equipment especially the streamer cable is a newly developed no-fluid filled floatation cable for the survey is environmentally friendly.

- The administrators, opinion leaders, fishermen and the stakeholders in general in Contract Zone 2 were briefed and their views received during the EIA survey and this exercise is to continue on all landing sites in the area before the actual survey commences

The Action Plan being proposed is as follows:

a) Continuation of sensitization exercise of the fish landing communities in the survey area.

b) Display of the EIA report to administrators as well as to the fish landing communities

c) Before Seismic survey commences the survey team should hold discussions with the fishing communities and explain their programme of work and get them to understand what is expected of them.

d) The surveyors programme should be put on radio as already proposed

e) Actual Seismic Survey commences after the above activities.

6. Conclusions and Recommendations

6.1. The Lake Albert is very important to the economies of the two countries sharing it and all effort need to be made to avoid any activity that will affect the services that this lake provides to man especially fish.

6.2. The EIA suggest that the seiemic survey will have little or no impact in the aquatic organisms including fish.

6.3. The seismic survey will, however, interfere with fishing activities in Contract Zone 2. But this can be avoided or compensation can be made for destruction of gear.

6.4. It is therefore recommended that the seismic survey be approved as long as the arrangement are put in place to safeguard the fishing gears

6.5. The timing of the seismic survey should be planned in such a manners that it does not concide with the rainy season which is the peak breeding season for most fish.

Table 1 Distribution Of Families Genera And Species Of Fisheries In Lake Albert

FAMILY	NUMBER OF GENERA	NO OF SPECIES
Lepidosirenidae	1	1
Polupteridae	1	1
Mormyridae	5	7
Characidae	3	5
Cithrarinidae	2	4
Cyprinrinidae	4	5
Bagridae	2	3
Schilbeidae	2	2
Claridae	2	2
Mochokidae	1	3
Malapterurudae	1	1
Cyprinodontidae	1	1 or 2
Chichlidae	5	5,4,being E
Centropomidae	1	2 E
Anabatitidae	1	1

E = Endemic species : Source: Graham (1929)), Worthington (1929, 1932 ab), Trewavas 1933,1938, Poll 1939, EAFFRO Reports

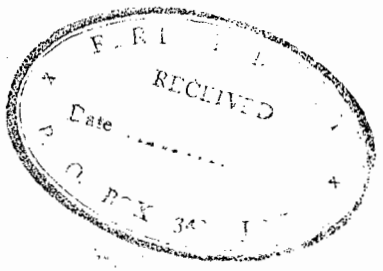

Table 2. The relative importance of fish in commercial catches at different landings along the shore of Lake Albert. Numbers in bracket are percentage contributions.

Bugoigo: Tilapines (30) Lates spp (20) Hydrocynus spp (15) Bagrus spp (15) Others: (15) (Alestes spp Clarias spp, Auchenoglanis spp, Barbus spp, Protopterus spp, Labeo spp, Malaptururas spp, Distichodus spp, Synodontis spp)	Kibiro: Hydrocynus spp (40) Lates spp (25) Alestes spp (19) Barbus spp (5) Tilapines spp (5) Others: (6) Auchinoglanis spp, Labeo spp, Synodontis spp, Clarias spp	Nkondo: Hydrocynus spp (72) Lates spp (15) Bagrus bayad spp (10) Others: (3) Alestes spp, Alestes spp, Auchinoglanis spp, Tilapines spp, Synodontis spp, Momyrus spp.
Walukuba: Hydrocynus spp (35) Lates spp (22) Alestes spp (20) Others: (23) (Tilapines spp, Bagrus spp, Barbus spp, Auchenoglanis spp, Distichodus spp, Clarias spp, Labeo spp, Synodontis spp,	Tonya: Hydrocynus spp (60) Lates spp (28) Others: (12) Bagrus spp Tilapines spp Alestes spp Synodontis spp Malapterurus spp Schilbe spp	Bugoma: Lates spp (60) Hydrocynus spp (20) Bagrus spp (10) Alestes spp (5) Others: (5) Auchinoglanis spp, Barbus spp, Labeo, Synodontis spp, Momyrus schall Malapterurus spp.
Butiaba: Hydrocynus spp (75) Tilapines spp (12) Alestes spp (5) Lates spp (2.5) Others: (5.5) Barbus spp, Auchinoglanis spp, Bagrus spp, Synodontis spp, Protopterus spp, Labeo spp, Clarias spp, Maleptrurus spp, Distichodus spp, Schilbe spp,	Kaiso: Hydrocynus spp (40) Lates spp (40) Alestes spp (5) Bagrus spp (5) Others: (10) Tilapines spp, Barbus spp, Protopterus spp, Labeo spp Auchoglanis spp, Clarias spp, Synodontis schall Malapterurus spp, Distichadus spp	Kitegere: Hydrocynus spp (55) Lates spp (25) Bagrus spp (5) Alestes spp (10) Others: (5) Synodontis schall, Tilapines spp, Barbus spp Auchoglanis spp, Labeo spp, Clarias spp, Protopterus spp

Source: Fisheries Department Statistics

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9. List of Figures

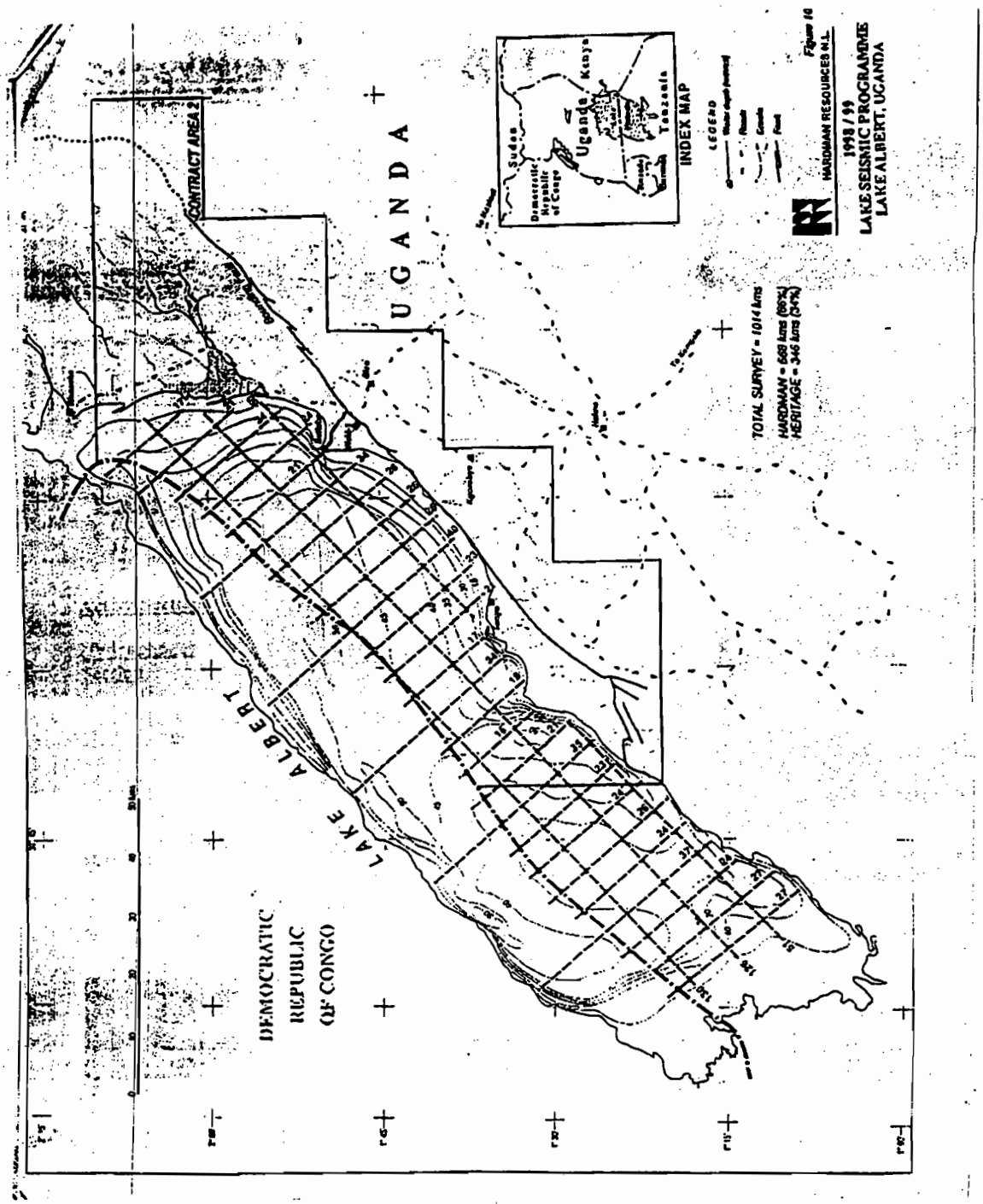
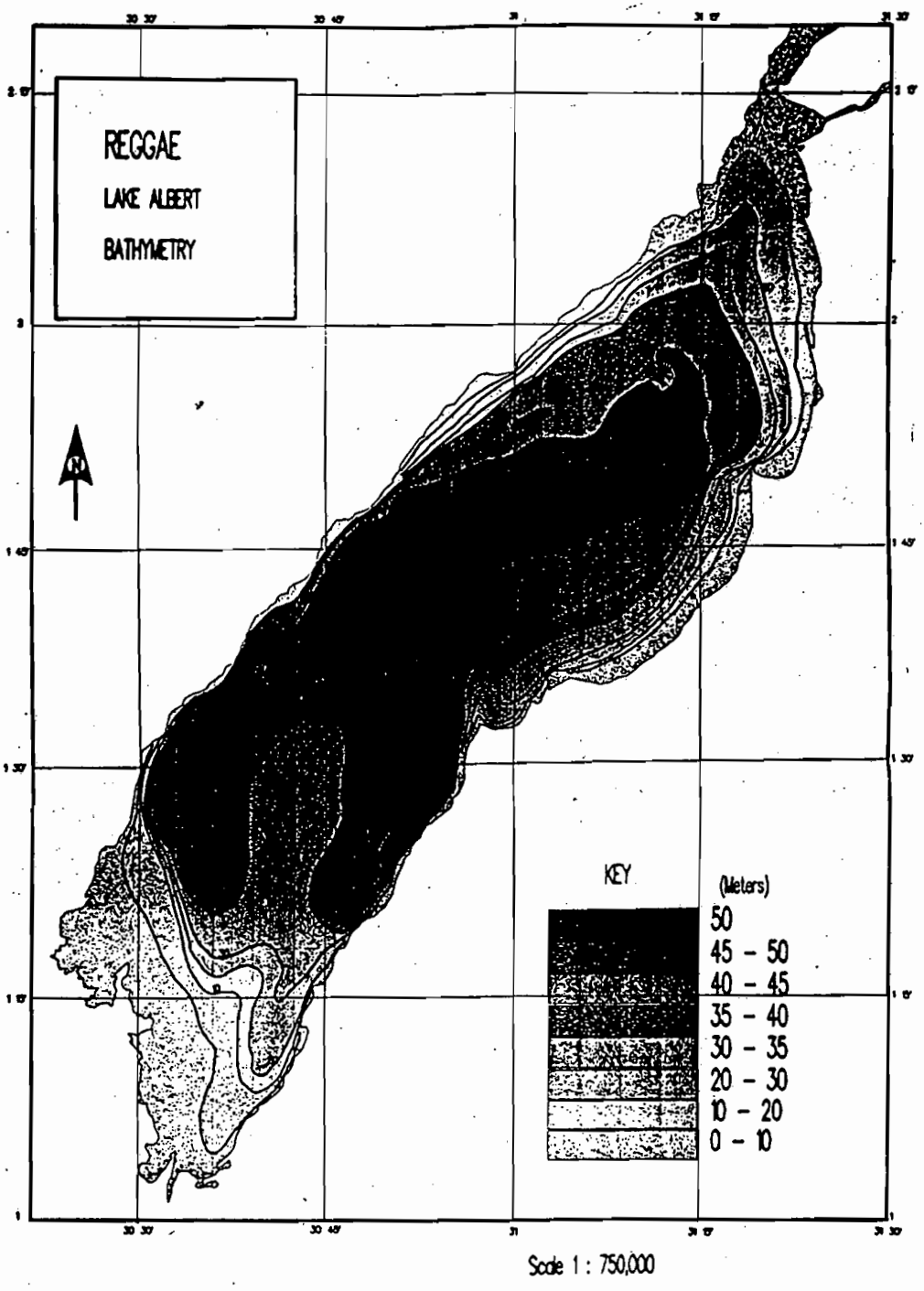


Figure 1. Map showing Contract Area 2 to be covered by the Seismic Survey.


REGGAE
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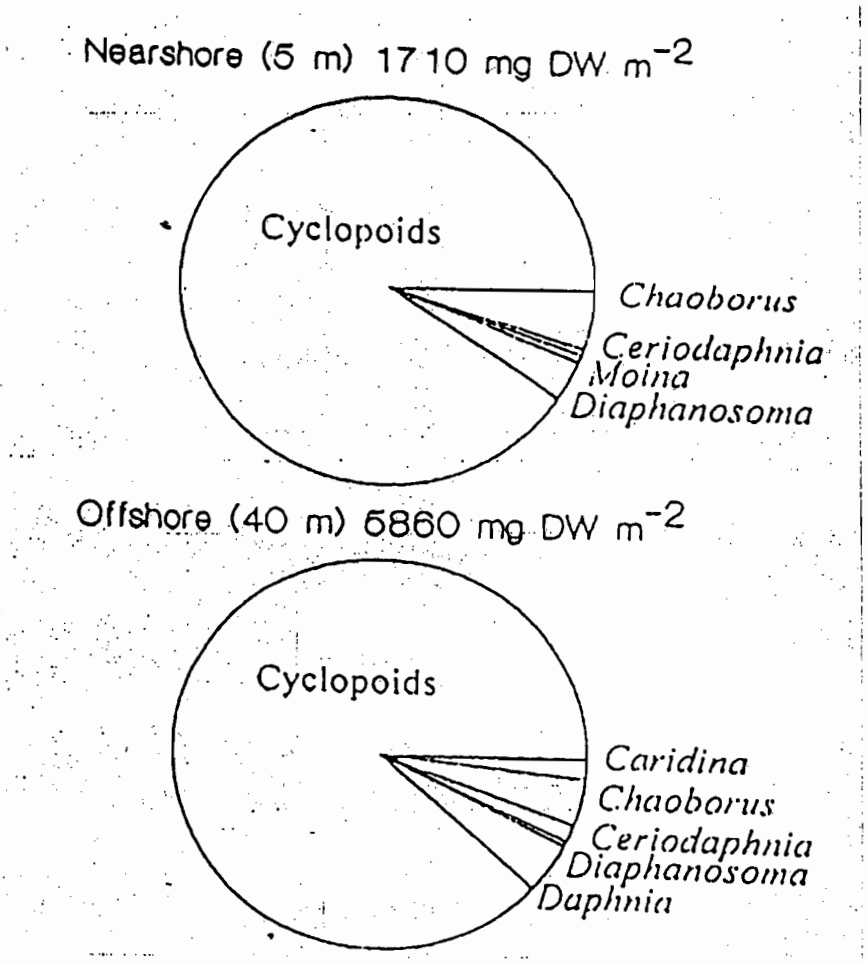

Figure 3. Relative abundance of zooplankton in Lake Albert at a nearshore (5 m depth) and an offshore (40 m depth) station Butiaba on Lake Albert. Based on data in Lehman *et al.* 1997

Annexes:

Annex I. List of people consulted

Entebbe: Mr Deo Mukiibi (Deputy Commissioner for Fisheries P); Mr Nsimbe - Bulega (Principal Fisheries Officer)

Masindi District Headquarters: Mr Jepa Ojok Angwe (ARDC - Bulisa); Mr John Majara (LC 5 Chairman Masindi District); Mr Jack Byaruhanga (Ag. CAO); Mr Emmanuel Oponya (DFO)

Butiaba Fish Landing: Odwong Micheal (O/C Police); Mr Mugisa Steven (Police Officer); Mr Keya (Coxswain, Fisheries Department); Asiimwe Abel (LC II Chairman); Fishermen (Byakika, Stephen Mwijakubi, Amosi Baraza, Agabo Robert, Kisembo P, Moses Muhumuza, Agaba Yowasi, Byarufu, Mugenyi, Bagashi, Ahmed Kizza, Kalekyo, Udongo, Pitwa, J. Muswa, Babyenda, Magezi;

Walukuba Fish Landing: James Onega (Centre Master); Mr Aliker Jakwo Nichani (Fisherman); Alphose Okumu (hunter;

Bugoigo (Kigungu) fish landing: David Olwe (Fisherman), Wandera Francis (Chairman LCI), Gahwera (Defence of Kisiabi), M. Bitahwa (Fisherman), John Kasigwa (Fisherman), Seremosi Rugongeze, John Mutuza, Kyoma Langton, Asiimwe Makandi, Charles Mulifakubi, Agaaba Bright, Asia Borotolo, Kikonde Wilson, Moses Musa, Asiime Mugasa, Rugadya Patrick, Mwesigwa Junaki, Ukoko Reginali, John Oroma, Bamuturaki Robert, Donvo Mulinda, Mukako, Selestiono, Kaaga Geyenya, Bakengesa Samuel, Bikoba Makandi, Kaaga Mujabi, Urombi, Udongo Isailya, Ayebale, Byesali, Katusabe Michael;

Bugoigo (Serule) fish landing: Kaliisa Kenneth, Perezi Ngambo, Ovochi, Mugenyi George (Chairman), Bala John, Micheal Owashegiu, Emilo Dratibi, Rashid Amori (Secretary, Security), Bigirwenkya Julian, Upio Chengo; Jackson Oroga, Pastor Amos Ogeng Ruth, Blandhina Ayio, Muswa J. Confort, Onyoi Alfred, Bamuturaki Seremos, Kalusto Amankari, Mukuundu Nurudin, Y. Kajuruga, John Adubango;

Kyamwana (Kachura) Fish Landing): Patrick Gabwemi, Kisembo Kalisa;

Kibiro fish landing: Katusiime Wilberforce (Fisherman), Yusufu Kato Bitagase, Josefat Nkumwire, Kisembo Karisa, Babyesiya Yofesi, Seezi Kiiza, Isingoma George, Byamuhanga, Fenekasi, Byenkya Solomon, Mwikirize Balyebinga, Byamukaga William, S. Tibanyenda, Willy Balyebuga, Kyalimpa Noahson;

Tonya (Kiryamboga) fish landing: Gahwera Perez, (Parish Councillor), Asaaba Robert (Sec. for Defence), Kyahurwa Simon, Katalibahwa Henry, Kato William, Tumwesige Julias, Lubeni Kaliisa, Businge, Robert (Gen. Secr. LCII & Movement), Tibamwenda Richard (C/master), George Katto, Balikenda Stephen, Kirungi Joseph, Muhumuza Fred, Kwonkya Neba,

Hoima District Headquarters: Mr Katetegire Inagius (RDC), Mr Kalisa John N (FDO), Mr E. Kiiza Rujumba (LC 5 Vice Chairman), Mr Ali Tinkamanyire (LC5 Finance and General Purpose Secretary), Mr Tumwebaze Mukiga (Ag. Deputy CAO), Ms Alice Kunihira (Office Assistant, CAO's Office)

Annex II. List of Fish Landings visited

The following are the landings visited:

Bugoigo (Kigungu); Bugoigo (Serule); Walukuba; Butiaba main; Butiaba (Kina); Butiaba (Songa); Kawaibanda; Waki; Ruunga; Kibiro; Bikungu; Kachura; Petye; Songa gagi; Hoima; Rwentale; Kiryambogo; Tonya; Sengamani; Nyanyama.